

PHYSIOLOGY OF THE NERVOUS SYSTEM.

On Localization of Function in the Brain. By Dr. VON GUDDEN.—*Biolog. Centralbl.*, Nos. 18 and 19, 1886.

Dr. Gudden approached the problem from the anatomical side. His object was to trace from the periphery towards the centre the distribution of the nerve fibres. If the physiologist, taking away different parts of the cortex to observe the result, does not know the distribution of the fibre systems in the cerebrum, he is certain to fall into error. Phenomena, due to secondary injury of the underlying fibres, will be ascribed to the cortex. In short, physiology must have its verdict corroborated by anatomy before the final judgment can be given. Any result drawn from the physiological study of the brain must be abandoned if it is contradictory to any well-established anatomical fact.

If you destroy the eye of a young rabbit, the opposite optic tract, as far as it is developed, will atrophy, with the exception of the uncrossed bundle of fibres. This, in the rabbit, is so insignificant, that an animal possessing it alone in one eye is blind in that eye. Following the atrophy of the optic tract will be that of the primary subcortical centres—the external geniculate body (the centre for the pupillary reactions), and the upper layer of the anterior corpus quadrigeminum (the visual centre). From here, by means of the connecting fibres, the secondary cortical centre of vision should degenerate; but no difference, except that due to the shifting caused by the atrophy of the anterior corpus quadrigeminum, can be noticed in the cortex. Microscopic examination reveals no difference in the size or number of the cells, and simply shows that the part above the atrophied anterior corpus quadrigeminum, having more room to develop, has developed more. The effect of extirpating both eyes is practically to duplicate these appearances on the other side. Sections of the other sensory nerves promise equally definite results.

Special attention is given to the atrophy of the olfactory nerve. The glomerulus layer of the olfactory bulb is the primary smell centre, and the rest of the bulb is cerebral. Proof of this will be given elsewhere. Part of the anterior commissure serves exclusively to connect the olfactory lobes. The importance of the olfactory nerve consists in the fact that the manner of the connection of its centre with the cortex is clear. If you destroy the olfactory membrane of one nostril of a young rabbit, you will cause the atrophy of the glomerulus layer of the bulb. Or better, if you separate, by the insertion of a fine knife within the cranium, the olfactory bulb from the lobe and allow the animal to grow up, you will find (1) a line of loose connective tissue at the point of section (reunion of nervous tissue does not occur within the brain); (2) the olfactory tract gone; (3) the olfactory lobe to all appearances normal.¹ This fact of the preservation of the lobe when separ-

¹ A microscopic examination showed a slight alteration of the cells in one out of three specimens. It is suggested that this may have been due to a meningitis.

ated from its nerve, Dr. Gudden, remembering that comparative anatomy showed that the development of the lobe was proportional to the size of the nerve, explained as due to the connection with the opposite olfactory lobe through the anterior commissure. This view had to be abandoned when he succeeded in separating both bulbs from their lobes and yet found practically no alteration in the lobes. Upon the interdependence of the development of the olfactory nerve, bulb, and lobe on the one hand, and on the (nearly) normal development of the lobe in separation from its tract and atrophy of the bulb on the other hand, Dr. Gudden bases his view of the localization of function in the brain.

The same is true of motor nerves. The facialis, hypoglossus, etc., can be cut without causing a degeneration in the cortex.

If the entire hemisphere of the brain of a young rabbit, including the corpus striatum but not the optic thalamus, be removed and the animal allowed to grow up, no difference in the sight, hearing, or feeling of such animal is noticed. They behave perfectly normally, and show no difference between the sensibility of the two sides. No anatomical basis for the unilateral control of the brain is as yet found. The main point to be noticed is that the sight centre (upper layer of anterior corpus quadrigeminum) was in no way altered, and the optic tracts and nerves were alike on both sides.¹

Dr. Gudden succeeded in destroying the left parietal and occipital lobe of a four-weeks-old kitten without producing hemiopia (though the so-called visual centre in the occipital lobe was destroyed), and moreover both optic tracts were equally developed. More remarkable is the following case. The entire occipital and parietal lobes of *both hemispheres* were removed from four young rabbits. They developed apparently like normal animals, and as regards vision, they fled when a hand was waved at them from a great distance, jumped from heights, avoided all obstacles; in short, though without the slightest trace of either visual area, they saw and interpreted what they saw. In another series of rabbits the frontal lobes on both sides were removed and yet the animals saw, heard, felt, and moved as normal rabbits. If, however one makes a deep incision into the brain and removes much of the matter, many of the rabbits die; and the survivors, though they see, hear, and feel in a rudimentary way, yet show peculiarities, are sleepy, idiotic, puny, weak, etc.

As the primary sight centre does not atrophy when the occipital lobe is destroyed, so the subcortical centres of all sensory and motor nerves remain intact when they are separated from the cortex. If you cut off the olfactory lobe, the glomerulus layer remains intact, only the small part of the tract belonging to the lobe remains, and the commissural fibres of this part are gone.

¹ Dr. Gudden enters into a controversy as to how far this relation is true in the higher animals, in which he considers that the one negative case is conclusive, and that in those cases in which some atrophy does occur, it is secondarily caused.

Passing from these facts, gained with much labor and difficulty, to their interpretation, one must be still more careful. They certainly do not favor the view of exactly localized, circumscribed, functional, distinct areas; nor does the histological character of the cortex favor such a view. The objection that results derived from the study of the brains of young animals are not entirely applicable to mature brains, is not without weight. But similar facts can be shown in fully developed animals, although half-grown ones, owing to their greater vitality and smaller liability to secondary atrophies, are preferable.¹ Dr. Gudden has the brains of two full-grown dogs, which show no atrophy of the optic tract, though the visual area was destroyed; and no such operation can be used as evidence for making out a certain area to be the sight centre, unless the atrophy of the optic tract (if it occurs) can be shown not to be due to secondary causes. In the motor area, the difference between operating on a young and on a mature animal is marked; the former can bear the removal of the frontal area without motor disturbance, while the latter suffers considerably, but even then the effects are not permanent. The anatomical effect is in rabbits a complete, in cats an incomplete, atrophy of the pyramidal tracts. A dog, both of whose motor areas were removed by Prof. Golty, was very awkward in its motions, but not paralyzed. A series of young rabbits similarly operated showed very serious motor disturbances, but even here, as the animals grew up, the effects gradually grew less and less. But all these experiments are only in their infancy, and it was the expressed intention of Dr. Gudden not to draw any but provisional conclusions until more evidence was collected.

Dr. Gudden does not believe in exact localization, but does not oppose all localization whatever. The anatomical relations on which this position is based are, by way of summary: (1) in the whole mammalian series there is a constant relation between the development of the olfactory lobe and that of the bulb and nerve. One must remember that the rabbit, both of whose olfactory lobes were separated from the bulbs, and yet the lobes developed normally, argues against the olfactory lobes as the exclusive centres of smell. At any rate this suggests a modification of the theory. (2) Removal of the frontal lobes, and of these alone, causes atrophy of the pyramidal tracts; hence the frontal lobes have a special function. (3) The dependence of the lemniscus upon the parieto-occipital lobes, first shown by Gudden. (4) Some of the nuclei of the thalamus are independent of the cortex. (5) The medial posterior ganglion of the mammillary body is also dependent on the parieto-occipital region, but not on the frontal.

All that these facts show is that the division into motor and sensory functions of the cortex is justified. To go on with this study one must cut the subcortical fibres and trace the degeneration in the cortex. For this purpose, Dr. Gudden cut (through

¹ Dr. Gudden mentions some of the cautions to be observed in operating, etc., for which reference is made to the original paper.

the foramen opticum) the middle third (pyramidal tract) of the internal capsule. Subsequent examination showed that the attempt was almost entirely successful. The result was a degeneration of *large* motor cells only in the cortex. This suggests that the different cell layers of the cortex may have different functions.

In fine, enough has been said to show that much remains to be done to complete the doctrine of the localization of function in the brain. *First* anatomy and *then* physiology, was Dr. Gudden's watchword ; but if physiology first, then not without anatomy.

J. J.

THERAPEUTICS OF THE NERVOUS SYSTEM.

The Result of Nerve-Stretching for Facial Spasms Five Years after the Operation.—Mr. F. A. SOUTHAM, in a "note" in the *Lancet*, April 10, 1886, states that there has been no return of the spasm, though five years have elapsed. The case was previously published in the *Lancet* five months after the operation. The spasm had been of two years' duration. The operation was followed by complete paralysis of all the muscles supplied by the facial nerve. At the end of five months the paralysis had completely disappeared. S. refers to nineteen cases of this operation, collected by Tetas (*Wien. med. Wochenschr.*, Nos. 27 and 28, 1885, and this *JOURNAL*, Oct., 1885). In only two of these—viz., in one case, operated upon by Tetas himself, and in another by Navratil—in addition to the one above referred to, has the cure been permanent. In four cases there was considerable improvement, while in ten the operation failed to give more than a temporary relief ; in the remaining two cases the result was doubtful, as their subsequent history was not followed out. Inasmuch, however, as benefit has followed in seven out of seventeen cases, Tetas is of opinion that the operation should still be performed whenever the spasm is not due to intracranial lesions.

Antipyrin in Headache.—According to Dr. JOHN R. WHITE (*Med. Rec.*, Sept. 11, 1886) antipyrin "not only promptly relieves the symptoms of headache, whenever present, whether resulting from disordered digestion, disturbance of the menstrual functions, loss of sleep, undue mental effort, or even that associated with dreaded anæmia, but also possesses reliable prophylactic virtues against recurrent attacks of cranial neuralgia." Relief often follows a single dose of fifteen grains within half an hour. "A sense of drowsiness ordinarily supervenes, followed by a brief but sufficient slumber, and the patient awaking quite relieved from the distressing symptoms."

Urethane in the Treatment of Traumatic Tetanus.—Mr. W. T. JACKMAN publishes in the *Lancet*, June 12, 1886, a case